regarded as equations in t have a unique common solution, φ may be arbitrarily taken and $\theta = t\varphi$. The equations of l are $x - \kappa y = 3z - \lambda w = 0$ and the cubic is $x = \sigma^3$, $y = \sigma^2$, $z = \sigma$, $w = 1$; or finally the involution is $\sigma^3 - \kappa\sigma^2 + \mu(3\sigma - \lambda)$ a single one determined by each value of m.

Putting $X = x - \kappa y$, $Y = x - \lambda y$, $Z = 3z - \lambda w$, $W = 3z - \kappa w$ the planes $X = 0$, $Y = 0$, $Z = 0$, $W = 0$ are the faces of the tetrahedron whose edges are a, c, l, l'. The collineations ($X' = \rho_1 X$, $Y' = \rho_2 Y$, $Z' = \rho_1 Z$, $W' = \rho_2 W$) leave invariant the lines $abcdll'$ evidently but transform any cubic tangent to $abcd$ into an infinity of others.

The coincidence of the equation between m and n with the modular equation leads to this geometrical theorem. If four planes of a pencil of axis l touch a cubic and the tangents meet l in $ABCD$ and if the planes meet the cubic in simple intersections $A'B'C'D'$ then $\{A'B'C'D'\} = \{ABCD\}$.

STUDIES ON THE TRANSFORMATION OF THE INTESTINAL FLORA, WITH SPECIAL REFERENCE TO THE IMPLANTATION OF BACILLUS ACIDOPHILUS, II. FEEDING EXPERIMENTS ON MAN

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In a recent communication in these PROCEEDINGS 6, 1920, pp. 423–426 the results of feeding experiments with albino rats were presented. Similar attempts to implant *Bacillus acidophilus* in man have led to the following conclusions.

Thorough implantation may be effected by the daily administration of 300–400 grams of lactose, 300 cubic centimeters of a whey broth culture of *B. acidophilus* (McFarland nephelometer turbidity scale of 5), or by a combination of 150 grams of lactose and 150 cc. of the whey broth culture. Complete transformation of bacterial types may be brought about also by the daily use of 500–1000 cc. of acidophilus milk culture.

The same results are obtained with dextrin as with lactose, but dextrose, sucrose and maltose exert no flora-transforming influence.

The time required for changing the flora varies with the nature and the amounts of the material administered. The most rapid implantation was obtained with the *Bacillus adophilus* milk. In two of the subjects 500 cc. of the milk brought about marked alteration within two to three days. Some of the subjects that were but slightly affected by 500 cc. of the milk culture showed very pronounced transformation when 100 grams of lactose were added daily to this amount.

No change could be detected in the hydrogen ion concentration of the

feces during the experimental periods. The transformation of the intestinal flora from the usual mixed to the simple aciduric type cannot be ascribed, therefore, to increased acidity within the lumen of the intestine.

The presence of a reducing substance in the feces of subjects receiving transforming amounts of lactose is further evidence in support of the view that the lactose is at least in part carried into the large intestine and helps to create in it an optimum environment for the development of *B. acidophilus*.

Attempts to implant *Bacillus bulgaricus* in the intestine of man failed in every instance. The conclusions arrived at in the rat feeding experiments are borne out here.

Seventeen human subjects were employed in a total of 45 experiments. All but two of these subjects were apparently normal individuals. No restrictions were made in the daily diets, which continued essentially the same as before the investigation.

B. acidophilus milk possesses several advantages over ordinary sour and *B. bulgaricus* milk, aside from its property of transforming the intestinal flora. It is pleasing to the taste and smell. It does not become very acid or in any other way materially change its character even on long standing. The curd is soft and of a creamy consistency. The creamy appearance of the milk persists without appreciable wheying off. The product is prepared easily when proper precautions are taken. Pure strains of *B. acidophilus* must be employed which have been grown in milk sufficiently long to produce acidity and a soft curd within 24 hours when kept at a temperature of 35–37° C.

The same methods were employed in the routine examination of the feces as in the earlier experiments with rats, namely, the preparation and use of whey agar plates, Veillon tubes and Gram-stained slides. The plates and the Veillon tubes were particularly valuable and are strongly commended for work of this kind. The Veillon tubes aided not only in the detection of *B. acidophilus* colonies, but served admirably as an index of the disappearance of *B. coli* and other gas-producing bacteria from the intestine. It soon became evident that as the aciduric type of organisms materially increased in numbers the volume of gas in the tubes correspondingly decreased. A so-called complete transformation of flora was evidenced by the crowding of the whey agar plates with small fluffy colonies, the absence of gas from the Veillon tubes, as well as complete preponderance of the characteristic sea-urchin-like colonies throughout the tubes, and by the large numbers of Gram-positive rod-shaped organisms of the *B. acidophilus* type on the stained slides.

A full account of the authors' studies on the transformation of intestinal flora and the implantation of *Bacillus acidophilus* is now in the Yale University Press, and will appear in book form at an early date.